INSTRUCTION MANUAL

MODEL 131A
VCG GENERATOR

WAVETEK

Product Improvement Notice

Wavetek maintains a continuing program to make improvements to their instruments that will take advantage of the latest electronic developments in circuitry and components.

Due to the time required to document and print instruction manuals, it is not always possible to incorporate these changes in the manual.

Wavetek has manufactured your instrument, using metal film 1% tolerance resistors in place of 5% carbon resistors, wherever practical. This results in a substantial improvement in the overall performance of your instrument. Therefore, there may exist a discrepancy between the resistor used to manufacture your instrument and the resistor called out in the Parts List and Schematic Diagrams in this manual.

If field replacement of an affected resistor does become necessary, replacement may be made in accordance with the manual call outs. Wavetek, however, recommends replacement with the same type of resistor used in the manufacture of your instrument, whenever possible.

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SCOPE OF MANUAL

This manual contains instructions for operating, testing, and maintaining the Wavetek Model 131 and the 131A VCG Generator. The 131A is identical to the 131 with the addition of a step attenuator and a output impedance selector switch. The Wavetek product-improvement program ensures that the latest electronic developments are incorporated into the Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print these Instruction Manuals, it is not always possible to get these changes incorporated into the manual. In this case, data will be found on engineering change sheets at the back of the manual. If there are no change sheets, the manual is correct as printed.

SCOPE OF EQUIPMENT

The Model 131A is a precision source of sine, square, and triangle waveforms, with selectable and variable outputs over a dynamic frequency range of 0.2 Hz to 2 MHz. It can be manually operated with easy-to-use, front-panel controls and also offers frequency control by external voltage for either dc programming or wideband ac FM applications.

SECTION 1
SPECIFICATIONS

VERSATILITY

Waveforms
Sine ∿ , square ⊓ , and triangle △

Dynamic Frequency Range

50Ω OUT	0.2 Hz to 2 MHz
600Ω BAL OUT	0.2 Hz to 20 kHz
600Ω BAL OUT	Usable to 2 MHz

Ranges

X10	0.2 Hz to 20 Hz
X100	2 Hz to 200 Hz
X1K	20 Hz to 2 kHz
X10K	200 Hz to 20 kHz
X100K	2 kHz to 200 kHz
X1M	20 kHz to 2 MHz

Outputs
Sine ∿ , square ⊓ , and triangle △ , selectable; output is controlled with 60 dB step attenuator in 10 dB steps with overlapping vernier control. 50Ω output impedance, 20 V p-p into open circuit and 10 V p-p into 50Ω load from 50Ω source impedance. 600Ω output impedance balanced with center tap; 20 V p-p into open circuit and 10 V p-p into 600Ω balanced load from 600Ω balanced source impedance. Short circuit current is ±100 milliamperes.

NOTE

When 600Ω BAL OUT is used as a balanced output, the instrument signal common may not be tied to any external signal common unless the common is completely floating and no dc path exists to the 131A common (BNC shell).

Sync Output
Greater than 1 V p-p square wave into open circuit at 600Ω output impedance.

DC Offset
±5 V offset (±2.5 V offset into 50Ω load or 600Ω balanced load) controlled from rear panel; peak amplitude limited by the dynamic range of the amplifier output. DC offset voltage as well as waveform is proportionally attenuated by the step attenuator.

VCG—Voltage Controlled Generator
Frequency of generator may be dc-programmed or ac-modulated by external 0 to 5 V signal. Voltage control circuitry is capable of 1000:1 deviation of the output frequency. The VCG amplifier has a 100 kHz bandwidth and a slew rate of 0.1 V/μsec. The instantaneous frequency is the result of the sum of the dial setting and the externally applied voltage.

Stability

Short term	±0.05% for 10 minutes
Long term	±0.25% for 24 hours

Percentages apply to amplitude, frequency, and dc offset.

HORIZONTAL PRECISION

Dial Accuracy
±2% of full scale, 1 Hz to 2 MHz.

Electronic Frequency Vernier
One turn for approximately 1% of full scale change.

Time Symmetry
±1% through X100K range.

VERTICAL PRECISION

Sine Wave Frequency Response
Amplitude change with frequency less than:
0.1 dB from 0.2 Hz to 200 kHz
0.5 dB from 0.2 Hz to 2 MHz

Step Attenuator Accuracy
±0.25 dB/10 dB.

PURITY

Sine Wave Distortion
Less than:
0.5% on X10, X100, X1K, X10K ranges
1.0% on X100K range
2.0% on X1M range

Square Wave Rise and Fall Time
Less than 50 ns.

ENVIRONMENTAL

Temperature
All specifications listed, except stability, are for 25°C ±5°C. The generator will operate from 0°C to 55°C.

MECHANICAL

Dimensions
8½ in./21.6 cm wide, 5¼ in./13.3 cm high, 11½ in./29.2 cm deep.

Weight
8 lb/3.6 kg net, 11 lb/4.99 kg shipping.

Power
105 V to 125 V or 200 V to 250 V, 50 Hz to 400 Hz.
Less than 15 watts

NOTES

All specifications apply for frequencies obtained when dial is between 0.1 and 2 and at 10 V p-p into a 50Ω load.

It is possible to stop the generator from oscillating by applying a negative voltage when the dial is already set at minimum frequency. Inputs up to 30 V will not permanently damage the instrument, however.

SECTION 2
OPERATION

INSPECTION

The following procedures should be performed to assure the user that the instrument has arrived at its destination in proper operating condition. Complete calibration and checkout instructions are provided in Section 4 for determining if the instrument is within electrical specifications. If your instrument is a 131, disregard any instructions pertaining to the 600Ω balanced output or the step attenuator.

Checking Visually

After carefully unpacking the instrument, visually inspect the external parts for damage to knobs, dials indicators, surface areas, etc. If damage is discovered, file a claim with the carrier who transported the instrument. Retain the shipping container and packing material for use in case reshipment is required.

Checking Electrically

NOTE

Instruments are normally shipped connected for 115 V power unless 230 V power is ordered. Refer to the end of this section for conversion instructions.

The steps in this paragraph provide a quick checkout of instrument operation. If electrical deficiencies exist, refer to the *Warranty* in the front of this manual. The following test equipment, or equivalent, is recommended for performing this electrical inspection. (Refer to Page 4 and Figure 2-2 for operating control descriptions.)

Name	Manufacturer	Model
Oscilloscope	Tektronix	544
Oscilloscope Plug In	Tektronix	1A5
Counter-Timer	Monsanto	101A

1. Turn FREQ HZ selector to the X1K position. (This connects ac power to the unit and establishes the frequency multiplier).
2. Connect oscilloscope to the 50Ω OUT connector with a 50-ohm terminator and set the 50/600Ω selector to 50Ω.
3. Set frequency dial to the 1.0 mark and the frequency vernier to CAL position.
4. Set function selector to ∿ .
5. Rotate 20 V P-P MAX control to its maximum clockwise position, with the attenuator in the 0 dB setting.
6. Check for 1-kHz sine wave with greater than 10 V p-p amplitude on oscilloscope.
7. Select ⊓ and ⋀ with function selector and check for 10 V p-p amplitude on oscilloscope.
8. Turn frequency dial from maximum counterclockwise to maximum clockwise positions and check for frequency change.
9. Step the output attenuator through its range and verify attenuation at each step.
10. Rotate 20 V P-P MAX control from maximum clockwise to maximum counterclockwise positions and check for decreasing amplitude.
11. Rotate VERNIER control and check for frequency change.
12. Set VERNIER control at maximum cw and frequency dial at .02. Set frequency to 20 Hz with counter. Connect a 0 to +5 Vdc input to the VCG IN connector. Slowly increase voltage input from 0 to maximum and check that frequency of output waveform increases from approximately 20 Hz to 2 kHz.
13. Connect the 600Ω balanced output connectors to a differential input oscilloscope (Tektronix 1A5 plug-in or equivalent) as shown in Figure 2-1.
14. Set 50/600Ω selector to 600Ω.
15. Repeat steps 5 through 10.

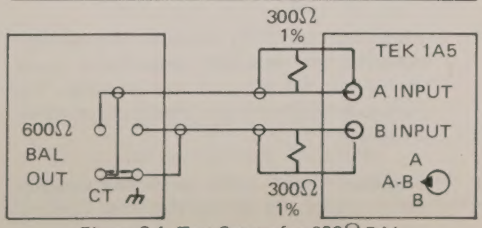


Figure 2-1. Test Set-up for 600Ω BAL

Figure 2-2. Operating Controls

OPERATING CONTROLS

The operating controls and electrical connections for the Model 131A are shown in Figure 2-2. The listing below discusses each control and its function.

1. **FREQ HZ/Power Switch** — This 7-position switch selects the generator frequency range. The extreme counter-clockwise position is the power off position.

2. **Frequency VERNIER** — This control allows precision control over the output frequency. A full turn of this control is approximately equal to one minor division of the frequency dial. When in the full clockwise position (CAL), the settings on the main dial will be calibrated.

3. **Frequency Dial** — The setting on this dial multiplied by the frequency range setting equals the output frequency of the generator. The frequency VERNIER also affects the generator frequency.

4. **Frequency Index** — The scribe line indicates the frequency dial setting. The index is illuminated when the unit is on.

5. **Function Selector** — This selects the waveform that appears at the 50Ω OUT connector. The waveforms are sine ∿, triangle ∧, or square ⊓.

6. **20 V P-P Max Control** — A vernier control of the output amplitude. Maximum clockwise position gives the full output amplitude of 20 V peak-to-peak into an open circuit or 10 V p-p into a 50Ω load, for 50Ω OUT and 10 V p-p into 600 balanced load. Counter-clockwise rotation will continuously reduce the output amplitude. The control gives a minimum of 40 dB variation (100:1), and operates in conjunction with the OUTPUT ATTEN (9). For maximum amplitude output this vernier must be full clockwise, and the output attenuator in the "0 dB" position.

7. **600Ω BAL OUT** — This connector provides the selected generator output function when the 600Ω output is selected. The generator may operate into an open circuit providing 20 V peak to peak maximum or into a 600Ω balanced load providing a 10 V peak to peak output.

8. **OUTPUT Selector** — Selects the output impedance of the generator, either 50Ω floating or 600Ω balanced.

9. **Output Attenuator** — This control attenuates the output amplitude according to the following table:

Attenuator Position	Output peak to peak into 50Ω or 600Ω Balanced Load	
	Maximum Vernier full cw	Minimum Vernier*
0 dB	10 V	1 V
−10 dB	3 V	300 mV
−20 dB	1 V	100 mV
−30 dB	300 mV	30 mV
−40 dB	100 mV	10 mV
−50 dB	30 mV	3 mV
−60 dB	10 mV	1 mV

*The values in this table are approximate. The 20 V p-p max attenuator will reduce the output nearly 40 dB in all cases. This table shows only a 20 dB reduction for simplicity.

10. **50Ω OUT** — This connector provides the selected generator output function when the 50Ω output is selected. The generator may operate into an open circuit providing 20 V peak-to-peak maximum, or into a 50Ω load providing a 10 V peak-to-peak output.

11. **VCG IN** — This connector allows external control of frequency. With 0 volts in, the generator output frequency is determined by the frequency range selected and the frequency dial setting. A positive VCG voltage will increase this frequency, and a negative voltage will decrease the frequency. Input impedance is 5 kΩ.

DC OFFSET — This rear panel control adjusts the amount of DC or baseline offset above or below signal ground. The detent position gives normal vertical symmetry.

SYNC OUT — This rear panel output provides a synchronizing wave output at the same frequency of the main generator. The output amplitude is greater than 1 V p-p into open circuit at 600Ω output impedance.

OPERATION

NOTE

One-half hour warmup is required for generator to stabilize at specified accuracies.

Operating as a Function Generator

1. Select output impedance by using 50Ω/600Ω selector.
2. Properly terminate the output connector in use.

NOTE

A proper termination results in 10 V p-p maximum output level. Open-circuit termination gives 20 V p-p.

3. Set the function selector to ∿, ⊓, or ⩘.
4. Set FREQ HZ range selector to desired multiplier.
5. Set desired frequency dial mark under illuminated index.

NOTE

The frequency VERNIER control must be in fully clockwise position for calibrated frequency operation.

6. Set OUTPUT ATTENuator for desired setting.
7. Set 20 V p-p max control for desired output level.

Operating as a VCG Generator

1. Set 50Ω/600Ω selector to desired output impedance.
2. Properly terminate the output signal. (50Ω or 600Ω).
3. Set function selector to ∿, ⊓, or ⩘ as required.
4. Set FREQ HZ selector to desired multiplier.
5. Connect external voltage source (dc programming or wideband ac signal) to VCG IN connector. When using the 600Ω OUTPUT the VCG IN BNC shell must not be connected to 600Ω CT or ground. See Figure 2-5.

NOTE

VCG input requires 0 to ±5 volts for operation over full-scale range, but can withstand many times maximum input.

6. Set frequency dial as follows:
   a. For frequency modulation with ac input, set dial for center frequency.
   b. For increasing frequency sweep with positive dc input, set dial to lower frequency limit.

c. For decreasing frequency sweep with negative dc input, set dial to upper frequency limit.

7. To sweep the audio range from 20 Hz to 20 kHz, set the controls to 20 Hz as follows:
   a. Set the main dial at .02.
   b. Set the frequency vernier at the full counterclockwise position.
   c. Introduce a 0 to +5 V ramp into the VCG input connector.

8. The nomograph in Figure 2-3 shows the characteristics of the VCG circuit. Column A gives the frequency dial setting; column B, the VCG input voltage; and column C, the approximate resultant dial frequency. Column C must be multiplied by the frequency range multiplier for the actual output frequency.

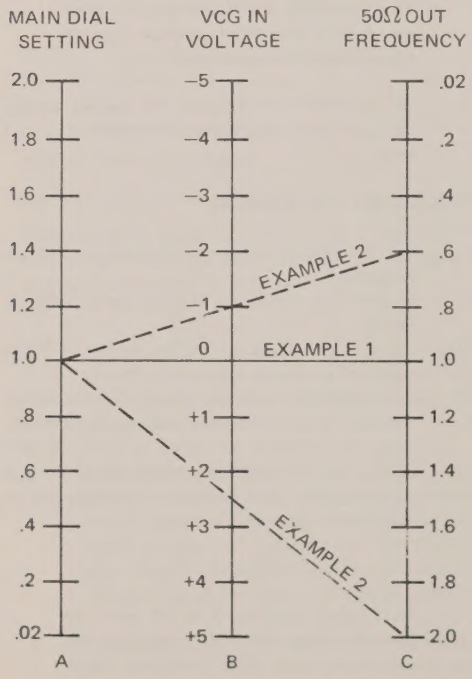


Figure 2-3 - VCG Voltage-to-Frequency Nomograph

In example 1, the dial is set at 1, and 0 volts is applied to the VCG input. Extend a straight line from 1 (dial setting) through 0 volts (VCG voltage) and obtain a dial frequency of 1. For the total output frequency multiply the range by 1 with the same dial setting, example 2 shows the results of using a ramp from −1 volts to +2.5 volts for the VCG voltage. This results in a swept output from .6 to 2.0 on the dial. Remember to multiply the dial times the range.

Converting to 230-Volt Line Power

Model 131A is shipped from the factory with the power transformer connected for 115-volt line power, unless ordered for 230-volt use. Converting a 115-volt unit for 230-volt operation is a simple matter:

1. Remove power cord.
2. Loosen two captive thumb screws on rear panel and remove panel.
3. The conversion switch is located on the chassis. Use a thin-bladed screwdriver to move the 115-230 switch to the 230 position.
4. Replace 1/4-ampere fuse with a 1/8-ampere fuse of the same type.

Connecting Signal Common and Chassis Ground When Using 600Ω Balanced Output.

The instrument is shipped from the factory with the signal common floating above chassis ground in order to obtain 600Ω balanced output from a single ended output amplifier. It is important to understand the grounding of the instrument before attempting to make any external connection to the BNC connectors or binding posts.

When the 50Ω/600Ω selector is switched to 50Ω, all the BNC connector shells are connected to the signal common. When it is switched to 600Ω, it is advised to restrict the BNC connector shells from connecting to any of the four binding posts of 600Ω BAL. OUT, since the BNC shells are connected to one of the balanced signal outputs. See Figure 2-5.

Connecting Signal Common and Chassis Ground When Using 50Ω Output.

1. Remove power cord.
2. Loosen two captive thumb screws on rear panel and remove panel.
3. Solder a jumper wire between the ground lugs (green wire) of the SYNC OUT connector and the power connector (Figure 2-4).

4. This connection must be removed when using the 600Ω balanced output.

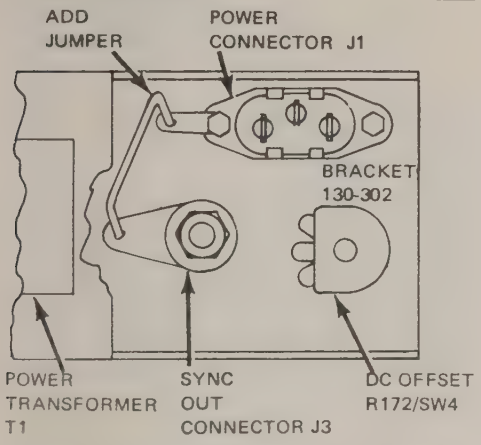


Figure 2-4. Common Ground Connection Diagram

Connecting Sync Out to an Oscilloscope

When in the 600Ω balanced mode, the SYNC OUT connector must not be connected directly to an oscilloscope since the BNC shells are connected to one of the balanced output signals. Connecting directly to the scope without isolating with a pulse transformer will cause attenuator B (see Figure 2-1) to be shorted, thus, one-half of the output impedance (300Ω) will be lost. The amplitude will remain the same, but the result is a 300Ω single ended output. An error in signal common connection will not damage the instrument. See Figure 2-5.

The VCG IN may be connected to any ac or dc voltage source if the signal common is floating from earth ground.

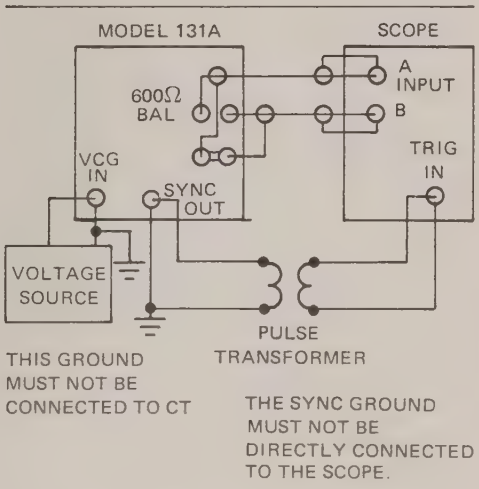


Figure 2-5. 600Ω Sync Out Connections

Connecting Chassis Ground to Center Tap

If it is desirable to balance the 600Ω output about chassis ground, connect the center tap (CT) to the chassis by placing the metal strap between CT and chassis on the binding posts.

SECTION 3
CIRCUIT DESCRIPTION

GENERAL DESCRIPTION

Refer to the block diagram of the Model 131A Function Generator, Figure 3-1.

Basically, a square wave is applied to the input of an integrator composed of a wideband differential dc amplifier, integrating resistor R, and capacitor C. The output of the integrator is fed into the hysteresis switch. The hysteresis and output switches function like a Schmitt trigger with the limit points set at the waveform extremes, firing when the triangle wave reaches +1.25 volts and −1.25 volts. The firing sets the hysteresis and the output switches which reverse the square wave fed into the integrator, causing the triangle wave to reverse direction. The result is simultaneous generation of a square wave and triangle wave of the same frequency with the positive half cycle of the square wave coincident with the negative slope of the triangle wave.

The frequency of oscillation is determined by the magnitude of the capacitor across the integrator and the amplitude of the current into the integrator. The capacitance across the integrator is changed by rotating the frequency Hz selector. The amplitude of the current into the integrator is determined by four parameters which are summed in the VCG circuit: 1) The ±5 volt square wave fed from the hysteresis switch, 2) the frequency dial voltage, 3) the frequency vernier voltage, and 4) the VCG analog voltage input.

The sine wave is produced by shaping the triangle wave. The triangle wave is fed into a shaping network

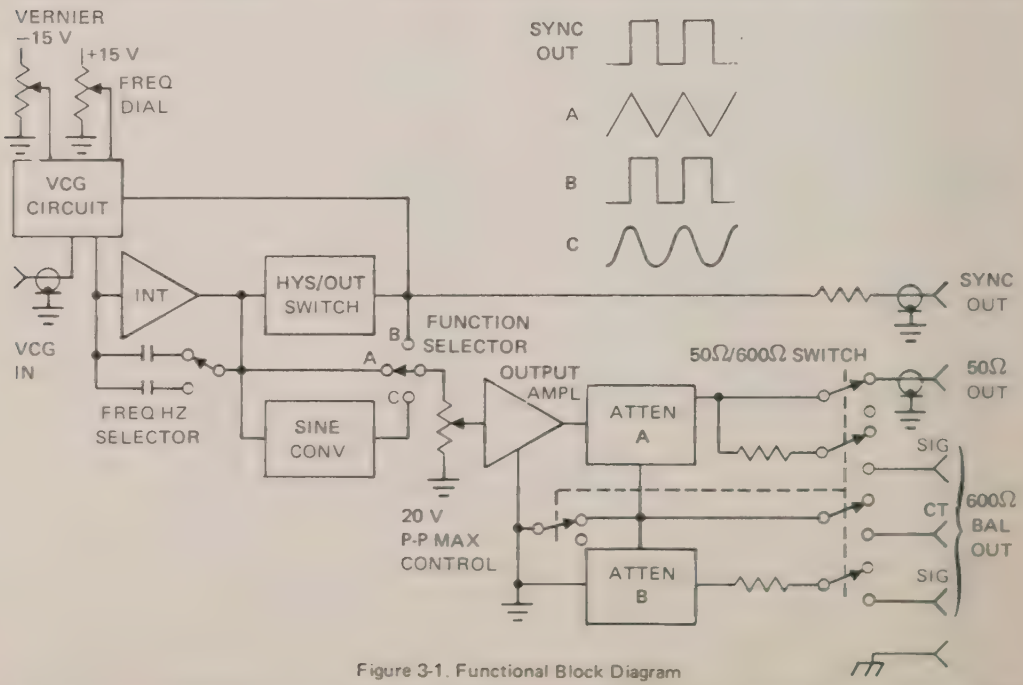


Figure 3-1. Functional Block Diagram

composed of resistors and diodes. As the triangle wave voltage passes through zero, loading of the triangle wave is minimal and thus the slope is maximum. As the triangle wave voltage increases; diodes with current limiting resistors conduct, successively, causing the slope of the output to be less.

Since the diode break points are mathematically computed and fitted to the true sine shape, the resultant waveform is an almost pure sine wave. The circuitry is completely symmetrical about ground, using a complimentary pair of diodes on each break point. The sine wave produced by shaping is considerably less in amplitude than the triangle wave input and is thus amplified to be equal to the triangle wave.

The triangle wave output of the integrator, the sine wave output, and the square wave coupled through a divider are fed to the function selector switch. The switch is coupled to the attenuator which in turn drives the output power amplifier.

All instrument circuits, except the switch set and the power amplifier output stage, operate with regulated ±15 volt supplies. The switch set requires regulated ±6 volts. The power amplifier output stage required unregulated ±22 volts.

In the Model 131A, a precision step attenuator and an output impedance selector switch is placed between the output amplifier and the output terminals. This circuit allows the output impedance to be selected, either 50Ω single ended or 600Ω balanced. In both cases the properly terminated output signal is 10 V p-p. When the output impedance selector is in the 50Ω position, all positions on the step attenuator provide 50 ohm impedance. When in the 600Ω BAL OUT position, each position on the step attenuator provides 600Ω balanced about signal ground.

SECTION 4
MAINTENANCE

INTRODUCTION

This section provides instructions for testing, calibrating, troubleshooting, and repairing the Model 131 and 131A. The additional features of the 131A require additional calibration. The instructions are concise and for the experienced electronics technician or field engineer. Wavetek maintains a factory-repair department for those customers not possessing the necessary personnel or test equipment to maintain the instrument. If an instrument is returned to the factory for calibration or repair, a detailed description of the specific problem should be attached to facilitate the turnaround time. Test point and adjustment locations are illustrated in Section 5.

RECOMMENDED TEST EQUIPMENT

Table 4-1 contains a list of recommended test equipment. Any test equipment having equivalent accuracies may be substituted for those listed.

Table 4-1. TEST EQUIPMENT

Name	Required Characteristics	Recommended Manufacturer	Model
Oscilloscope	To 30 MHz	Tektronix	544
Plug-In	Dual Channel	Tektronix	1A1
Plug-In	Peak mV measuring capability	Tektronix	1A5
Distortion Analyzer	To 600 kHz	Hewlett-Packard	334A
Spectrum Analyzer Display	To 50 MHz	Hewlett-Packard	141S
IF Section		Hewlett-Packard	8552A
RF Section		Hewlett-Packard	8553L
Voltmeter	Millivolt dc measurement		.01% Accuracy
Counter	To 10 MHz		0.1% of reading accuracy

CHECKOUT AND CALIBRATION

The following paragraphs provide complete sequential calibration procedures for the Model 131A. Instrument checkout procedures are indicated by a checkmark (✓) following the procedure title. A quick checkout of the instrument can be performed by comparing the indicated parameters with the tolerances given in the **Specifications** of Section 1.

NOTE

The entire calibration procedure must be read first to determine initial control settings and test equipment connections before attempting checkout.

Preliminary Procedures

1. Set FREQ HZ selector to the X1K position.
2. Set 50Ω/600Ω selector to 50Ω.
3. Set OUTPUT ATTENUATOR to 0 dB.
4. Allow one-half hour for warmup.

Power Supply Regulation

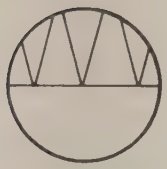
1. Connect voltmeter between TP1 (common) and TP2 (+) on Main Board. Adjust R104 for +15 Vdc ±100 mV.
2. Connect voltmeter between TP1 (common) and TP3 (−). Since the negative supply is referenced to the +15-volt supply, the voltmeter should indicate −15 Vdc ±100 mV.

Square Wave Amplitude Symmetry

1. Set function selector to ⊓⊔ .
2. Connect oscilloscope, with 1A5 plug-in, to coaxial-wire lug on function switch.
3. Using a comparator, set the positive peak to the center of the scope. Switch the comparator to the negative peak and adjust R121 so that the negative peak equals the positive peak.

Triangle Amplitude

1. Set frequency dial for 2.0 (X1K range) and function selector to ∿ .
2. Connect oscilloscope, with 1A5 plug-in, to red-wire lug on function switch.
3. Adjust R56 on main board for positive peak at +1.25 volts ±5 mV (see sketch).
4. Adjust R59 for negative peak at −1.25 volts ±5 mV.



Negative Peak

Positive Peak

Output Amplifier ✓

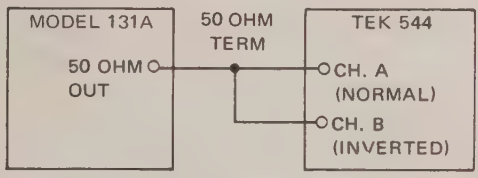
1. Connect oscilloscope to 50Ω OUT connector with 50-ohm terminator (⊓⊔ function).
2. Set FREQ HZ selector for X1K (VERNIER full cw) and frequency dial at 2.0.
3. Turn 20 V P-P MAX control fully ccw.
4. Adjust R150 for amplitude symmetry about ground.
5. Set FREQ HZ selector for X1M (2.0 dial setting).
6. Turn 20 V P-P MAX control fully cw.
7. Adjust C64 for best square-wave response without peaking.

First VCG Null ✓

1. Connect oscilloscope to 50Ω OUT connector.
2. Set FREQ HZ selector to X1K. Set dial at 1/100 of full scale.
3. Short and open VCG IN to signal ground (outside of BNC connector) while monitoring output frequency variation. Adjust R11 for minimum frequency change.

Time Symmetry ✓

1. Connect unit and oscilloscope, with 1A1 plug-in set for alternate display, as shown in Figure 4-1.
2. Set FREQ HZ selector for X100K with VERNIER in full cw position (⊓⊔ function).
3. Set frequency dial for 2 kHz on oscilloscope (1/100 dial FS).
4. Adjust R28 for time symmetry at 100:1 frequency ratio.
5. Turn VERNIER fully ccw and adjust R22 for time symmetry at 1000:1.
6. Repeat Steps 4 and 5, as necessary, for optimum symmetry at 100:1 and 1000:1.
7. Check for waveform time symmetry at the .2 and 2 frequency-dial settings.
8. Check to assure FREQ HZ selector is set to X100K position with VERNIER turned fully ccw.
9. Turn frequency dial fully cw.
10. Check for 1000:1 frequency ratio.
11. Adjust R8, if necessary, for slightly greater than 1000:1 ratio.



Trigger: Internal

Display: Alternate

Time Base: 50 microseconds/cm for 1/100 of 200 kHz
500 microseconds/cm for 1/1000 of 200 kHz

Figure 4-1.
Time Symmetry Measurement for Test Setup

Frequency Calibration ✓

1. Connect counter to 50Ω OUT connector.
2. Set FREQ HZ selector to X10K and VERNIER fully cw.
3. Align 2.0 dial mark with the dial indicator index and alternately switch from X10K to X1K range while adjusting R4 for a balanced error between the two positions.
4. Set FREQ HZ selector to X100K and dial at 2.0.
5. Adjust C16 to obtain 200.0 kHz on counter display.
6. Set FREQ HZ selector to X1M. Adjust C12 to obtain 2.00 MHz on counter display.
7. Dial alignment — No alignment is necessary if the dial is the push-on type. If it has a set screw, consult the factory for CAL procedure.

Sine Distortion, Amplitude, and Balance ✓

1. Set FREQ HZ selector for X1K (VERNIER full cw), function selector to ∿, and frequency dial at 2.0.
2. Connect oscilloscope, with 1A5 plug-in, to orange wire on function switch.
3. Adjust R133 to obtain 2.5 V p-p ±25 mV output.
4. Adjust R128 to balance output.
5. Connect the unit, distortion analyzer, and oscilloscope as shown in Figure 4-2.
6. Adjust R126 and R127 for minimum sine distortion (see photo).

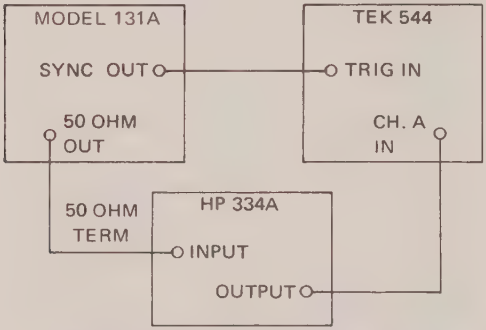
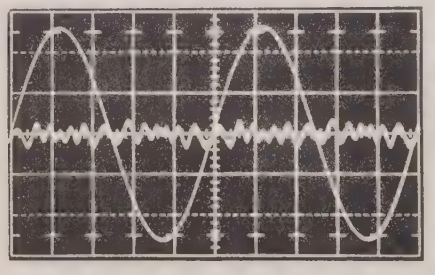


Figure 4-2. Distortion Analysis Test Set-up.



7. Set FREQ HZ selector to X10K.
8. Repeat Step 6 for Steps 1 and 7 to obtain least distortion at both X1K and X10K ranges.
9. Repeat Steps 2, 3, and 4.
10. Connect spectrum analyzer and check sine distortion at 2 MHz.

TROUBLESHOOTING

Basic Techniques

Troubleshooting the Model 131A requires no special technique. Listed below are a few reminders of basic electronics fault isolation.

1. Check control settings carefully. Many times an incorrect control setting, or a knob that has loosened on its shaft, will cause a false indication of a malfunction.
2. Check associated equipment connections. Make sure that all connections are properly connected to the correct connector.
3. Perform the checkout procedure. Many out-of-specification indications can be corrected by performing specific calibration procedures.
4. Visually check the interior of the instrument. Look for such indications as broken wires, charred components, loose leads, etc.

Troubleshooting Chart

Table 4-2 provides a list of possible malfunction symptoms, their probable causes, and the prescribed remedies. Also listed in this table are the test points at which measurements are to be made and the parameter tolerances at these points. To use the troubleshooting chart, locate the symptom listed in Column 1 and follow the corresponding procedures. Localize the fault to a specific stage by checking the parameters given for the major test points. Then check the dc operating voltages at the pins of solid-state devices. Check associated passive elements with a high input impedance ohmmeter (power off) before replacing a suspected semiconductor element.

Troubleshooting Hints

The interactive nature of a closed loop presents a somewhat special problem when approached from a troubleshooting standpoint. The simplest way to reduce problem complexity is to open the loop, thereby removing the interaction. The basic units of the loop can then be tested individually. The following step-by-step procedure describes how this is done. (The generator loop is all contained on the Main Board.) Consult next paragraph for removal of cover and panels.

1. Set instrument controls for 20 V p-p, 2 kHz sine-wave output.
2. Check at coaxial-wire lug of function selector switch for a 2.5 V p-p square wave. If normal, check output amplifier (Q34-Q40).
3. Unsolder and lift the end of R51 (TP7). This is the output of the integrator and input to the hysteresis switch. The generator loop has now been opened.
4. Inject a 2.5 V p-p triangle waveform into the hysteresis switch input lead (TP7).

Table 4-2. TROUBLE SHOOTING CHART

Symptom	Probable Cause	Corrective Procedures
No outputs at 50Ω OUT connector	Blown fuse	Replace F1 a. 1/4A—115 Vac b. 1/8A—230 Vac
	Power Supply	Check TP1/TP2 for +15 V; TP1/TP3 for −15 V; TP1/TP5 for +6 V; TP1/TP6 for −6 V. Troubleshoot associated regulator.
	Output amplifier	Check at wiper (grn/wht wire) of function selector switch for waveform as selected by position of switch. a. If waveform is present, troubleshoot output amplifier. b. If no waveforms are present, refer to **Troubleshooting Hints.**
	50Ω/600Ω Output Switch	Check to see that output is present at switch. If it is, the switch is defective.
No sine wave output	Sine amplifier	Check for 260 mV p-p sine wave at pin 4 of IC8. a. If present, check IC8 circuit. *NOTE:* Triangle wave must be present at pin 2 of A1 to obtain sine wave output. b. If *not* present, check A1 circuit.
No triangle, sine, or square wave	Generator loop	Refer to **Troubleshooting Hints.**
All waveforms low in amplitude	Power amplifier	a. Check front-panel amplitude control. b. Perform balance adjustment for power amplifier.
	Power supply	Check for proper voltages.
Frequency out of tolerance	Power supply	Check for proper power supply voltages as stated above.
	Maladjustment	Perform calibration procedure.
Sine wave not in spec	Maladjustment	Perform **Sine Distortion, Amplitude,** and **Balance** adjustment.
	Sine converter	Check for 260 mV p-p sine wave at pin 4 of IC8. a. If normal, check sine amplifier IC8. b. If abnormal, check A1 circuit.
Time symmetry of waveforms not correct	Maladjustment	Perform **Time Symmetry** and frequency adjustments.
Output impedance in the 600Ω BAL position is only 300Ω single ended	Half of output attenuator shorted	Isolate all BNC shells from CT or chassis ground. The common mistake is to connect sync out directly to scope without a pulse transformer.

5. Check at the coaxial-wire lug of the function selector switch for a 2.5 V p-p square wave at the injected frequency.
   a. If present, hysteresis and output switches are okay. Proceed to Step 6.
   b. If abnormal, check Q6-Q16 stages.
6. Vary frequency dial from ccw to cw while observing TP11 with a scope. Voltage at this point should remain at 0 volts throughout dial rotation. If a voltage variation is observed, check IC1 stage.
7. Vary frequency dial from ccw to cw while observing TP4. Voltage reading should vary from 0 to approximately −6 volts. If voltage does not vary, check IC2 stage and IC1 stage.
8. Vary frequency dial from ccw to cw while observing TP9. Voltage reading should remain at 0 volts. If voltage varies check IC3 stage.
9. Vary frequency dial from ccw to cw while observing TP10. Voltage should vary from 0 volts to approximately +6 volts. If voltage does not vary, check IC2 stage and IC3 stage.
10. Vary frequency dial from ccw to cw while observing TP8. Voltage reading should remain at 0 volts. If voltage varies, check IC4 and IC5 stages.
11. Re-install R51.

REMOVAL OF DUST COVERS AND PANELS

1. To gain access for calibration or maintenance, proceed as follows:
   a. Remove power cord.
   b. Loosen the two knurled captive screws on the rear panel.
   c. Pull off the rear panel.
   d. Remove the cover.
2. To gain access to any part mounted on bracket assembly behind rear panel, proceed as follows:
   a. Remove rear panel and dust cover as described in Step 1 above.
   b. Remove one heat-sink mounting screw.
   c. Remove bottom transformer mounting-block screw.
   d. Remove the two screws, lock washers, and hexnuts holding two wafers of FREQ HZ switch to bracket assembly.
   e. Remove four bracket-assembly retaining screws.
   f. Carefully pull bracket assembly to rear to obtain working room. Enough slack is available in the wiring for all normal operations.
3. To remove the front panel, proceed as follows:
   a. Remove rear panel and dust cover as described in Step 1 above.
   b. Remove all knobs, except frequency dial.

NOTE

Recalibration of the frequency dial is not required if the frequency dial is not removed.

   c. Unsolder BNC connections.
   d. Tag and unsolder frequency-dial potentiometer leads.
   e. Pull light bulb from indicator lens.
   f. Remove four front-panel retaining screws.
   g. Carefully pull off front panel with frequency dial/potentiometer still attached.

REPLACEMENT OF SWITCH WAFERS AND POTENTIOMETERS

1. To replace FREQ HZ switch wafer C or D or the VERNIER potentiometer, proceed as follows:
   a. Remove rear panel and dust cover as previously described.
   b. Separate bracket assembly from chassis as previously described.
   c. Tag and unsolder leads to part being replaced.
   d. Pull defective part off shaft and repair or replace with recommended replacement part.
2. To replace FREQ HZ switch wafer A or B, proceed as follows:
   a. Remove rear panel and dust cover as previously described.
   b. Remove front panel as previously described.
   c. Tag and unsolder wires to switch wafers A and B.

d. d. Unsolder wafer B PC-tabs from printed circuit board.
   e. Lift switch shaft slightly to free PC-tabs, rotate switch shaft so wafers clear board parts, and pull shaft end free of rear-mounted wafers C and D.
   f. Repair or replace defective part.
3. To repair or replace function selector wafers or 20 V P-P MAX potentiometer, proceed as follows:
   a. Remove rear panel and dust cover as previously described.
   b. Loosen set screws holding potentiometer and switch knobs to inner and outer shafts and remove knobs.
   c. Tag and unsolder wires to defective part.
   d. Unsolder potentiometer PC-tabs, lift shaft slightly to free tabs, rotate switch shaft so wafers clear board parts, and pull switch/

potentiometer assembly out of front panel hole.

e. Repair or replace defective part.

REPLACEMENT OF SINE CONVERTER

1. Remove rear panel and dust cover as previously described.
2. Unsolder the five pins of sine converter A1 from top of the printed circuit board, using a solder syringe.
3. Lift assembly from bottom of the board; a thin pencil-type soldering iron can be used, if necessary, to apply temporary heat during removal.

SECTION 5
DATA PACKAGE

INTRODUCTION

In this section are the schematics and assembly drawings for the Model 131A. Parts lists and list of manufacturers are included for ordering spare or replacement parts. IMPORTANT — When ordering a part from Wavetek, give all pertinent data — Part number, circuit reference number, value of the component and/or function performed.

LIST OF MANUFACTORERS

American Radionics . . . American Radionics, Inc.
Danbury, Connecticut

Amp . . . . . Amphenol Connector Division
Broadview, Illinois

ARCO. . . . . Arco Electronics
Great Neck, L.I., New York

Boots . . . . . Boots-Townsend Aircraft
Santa Ana, California

Corn . . . . . Corning Glass Works
Bradford, Pennsylvania

CRL . . . . . .Centralab
Division of Globe-Union
Milwaukee, Wisconsin

CTS . . . . . Chicago Telephone Systems
Los Angeles, California

Electro . . . . . Electro Cube, Inc.
Willow Grove, Pennsylvania

Erie . . . . .Erie Technological Products Inc.
Erie, Pennsylvania

Fair . . . Fairchild Semiconductor Corporation
Palo Alto, California

IMB . . . . . .IMB Electronics Products
Santa Fe Springs, California

IRC . . . . . IRC Inc.
Philadelphia, Pennsylvania

Kings . . . . . .Kings Electronics Co., Inc.
Tickahoe, New York

Littelfuse . . . . . Littelfuse Inc.
Des Plaines, Illinois

Motorola . . Motorola Semiconducts Products
Phoenix Arizona

RCA . . RCA Semiconductor Division
Somerville, New Jersey

Richey . . . . . Richey Electronics
Nashville, Tennessee

Semtech . . . . . Semtech Corporation
Newbury Park, California

HHSmith . . . . . Herman H. Smith, Inc.
Brooklyn, New York

Sprague . . . Sprague Electric Company
North Adams, Massachusetts

Stack . . . . . Stackpole Carbon Company
St. Marys, Pennsylvania

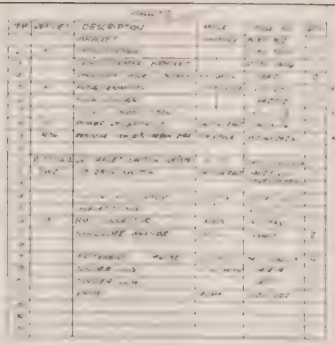
Switchcraft . . . . . Switchcraft, Inc.
Chicago, Illinois

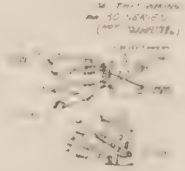
TI . . . . . .Texas Instruments, Inc.
Dallas, Texas

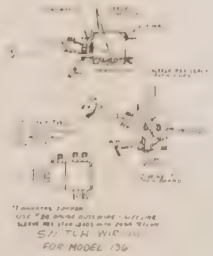
USECO . . . . . .USECO Inc.
Mt. Vernon, New York

Wakefield . . . . Wakefield Engineering, Inc.
Wakefield, Massachusetts

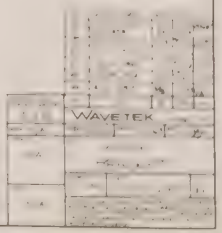
Wavetek . . . . . Wavetek
San Diego, California

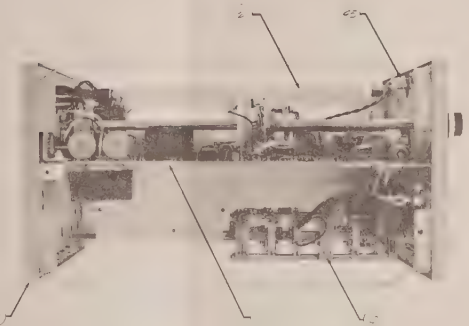


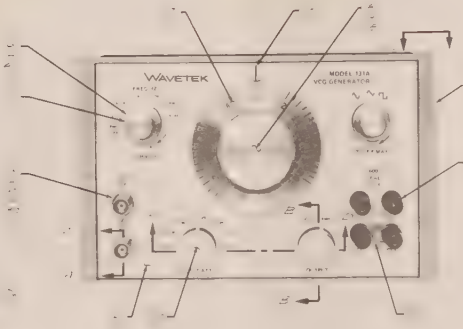




SWITCH WIRING
FOR MODEL 136







A-A

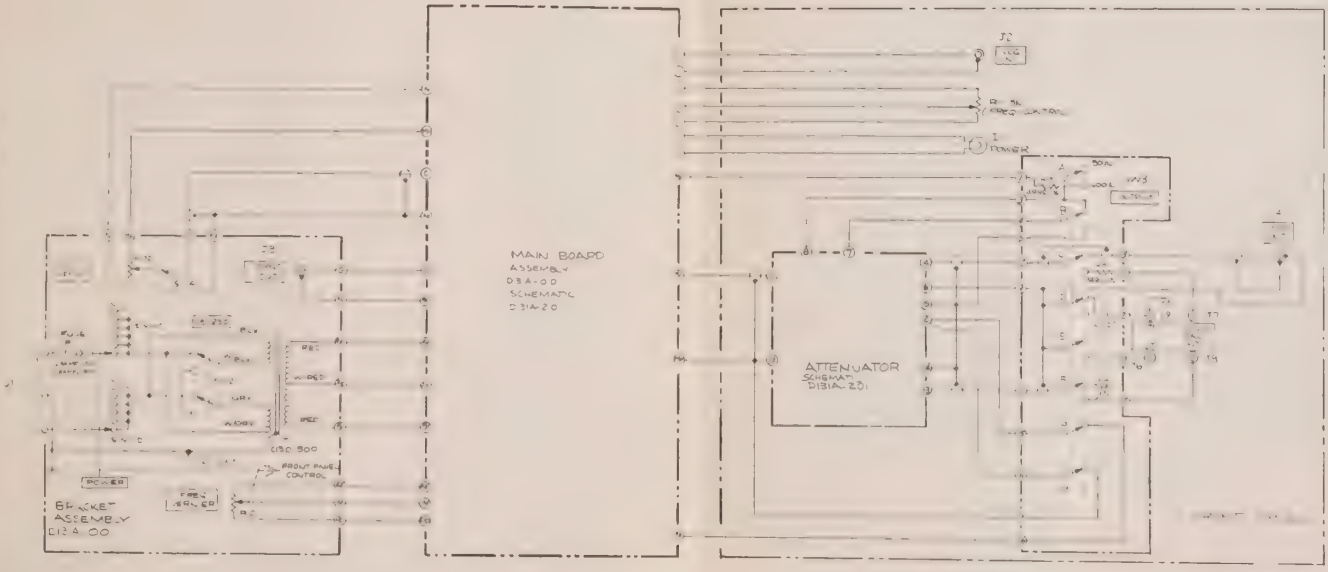
PARTS LIST

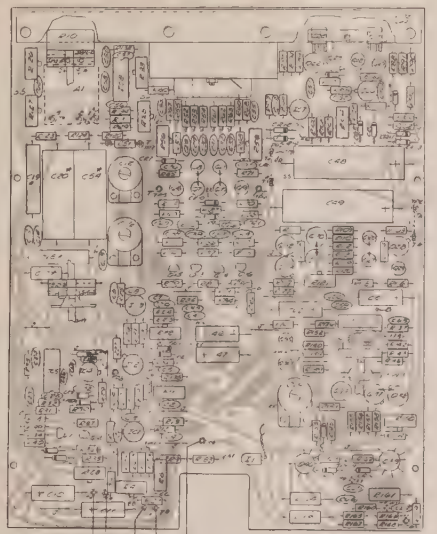
ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
1		MAIN BOARD ASSY	WAVETEK	D131A 010	1
2		[illegible]		[illegible]	
3		REAR CASTING		B130-300	1
4		CASTING MOD		B131-307	1
5		[illegible]		[illegible]	
6		SIDE PLATE		C130 304	2
7		DIAL		B130-333	1
8		DIAL KNOB		B130-306	1
9		[illegible]		[illegible]	
10		STANDARD KNOB		B130-350	2
		SMALL KNOB		B130-310	2
12		REAR PANEL		B130-303	1
13		DIAL INDICATOR		A141-317	1
14		BRACKET		B131-305	1
15		SUPPORT BLOCK		B131-306	1
16		COVER		C130-353	1
17		COVER, SUPPORT		A130-396	1
18	R1	POTENTIOMETER		A131-R1A	1
19		OUTPUT SWITCH ASSY		B131A-002	1
20		BAIL R[illegible]		[illegible] EC1	1
21		MOUNTING BLOCK		A130-305	1
22					
23					
24					
25					
26					
27					
28					

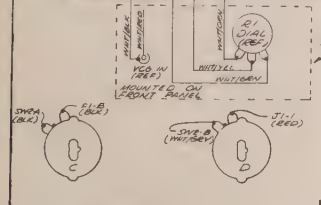
* INDICATES ITEM NOT SHOWN

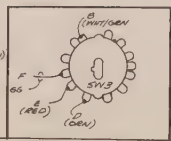
ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO.	QTY
29		CAPTIVE SCREW	DOLSTEN	7900 10 B 2 2	2
30					
31	J6,J9	BINDING POST	SURVIVOR	DFB1BC	4
32					
33					
34	J2,J8	BNC CONNECTOR	KING	KC 7946	2
36		SOLDER LUG	H SMITH	1410-A	1
37		SOLDER LUG	H SMITH	[illegible]	
38		SHOULDER WASHER	H SMITH	2660	4
39		SHOULDER WASHER	H. SMITH	2668	4
40					
41		BUSHING	TRIMTON	412 FF	4
42					
43					
44					
45		RETAINER		[illegible]	
46					
47		POWER CORD	BELDEN	17288-5	1
48					
49		SHOULDER WASHER	RCA	[illegible]	2
50					
51		[illegible] ER	CARR	[illegible]	1
52					
53		CHASSIS FASTENER	USECO	12918	4
54					
55		CAPTIVE FASTENER	TINNERMAN	CB0916SS	6

Tolerance unless otherwise specified
XXX ± .010
XX ± .030
WAVETEK
Material
Title
Scale
Sheet
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE REPRODUCED IN WHOLE OR IN PART, OR DISCLOSED TO OTHERS OUTSIDE THE SERVICE ORGANIZATION AND MANUFACTURING ORGANIZATION WITHOUT THE WRITTEN PERMISSION OF WAVETEK.


MAIN BOARD
ASSEMBLY
D3A-00
SCHEMATIC
D3A-20
ATTENUATOR
SCHEMATIC
D3A-221
BRACKET
ASSEMBLY
D3A-00
WAVETEK
SCHEMATIC -
CHASSIS







★ INDICATES MATCHED SET
2, 3 ★ = TERMINAL FACESIDE
3, 7 ★ = TERMINAL REARSIDE
4 ★ = SELECTED VALUE
1 ★ = MATCHED PAIRS

PARTS LIST

ITEM	REF DES	DESCRIPTION	VENDOR	VENDOR NO	QTY
1		SILVER SOLDER 60/40 .062	ARRL	ARRL60 MC	
2	C19				
3	C1				
4	C2				
5	C3				
6	C4				
7	C5	CERAMIC DISC 1000V 10%	CRL	DD 102	
8	C6, C65			DD 820	
9	R1, R2				
10	R3, R8			DD 330	
11	R4, R5			DD 470	
12	C63			DD 3937	
13	C40, C41			DD 681	
14	C7, C8, C56			DD 221	
15	C9, C62	10V 10%		CK 506	
16	C10, C11, C12, C13, C14, C15, C16, C17, C60	50V 10%		CK 103	
17	C18, C61	20V		CK 220-106	
18	C57, C60				
19	R1	POLY, 100K 1% .04	WAVETEK	130-401-E	
20	R2	1M			
21	C20, C38	MYLAR, 100V, 10%			
22	C21, C22, C23, C24, C25, C26, C27, C28, C29	ELECTROLYTIC, 16V, RADIAL	SPRAGUE	30D106X9016C2	
23	C30, C31			39D686X9035E2	
24	R9, C64, C49	VARIABLE 45-25PF	ERIE	563-001-014	
25	C32	CERAMIC DISC 1000V 50%	CRL	DD 102	
26	C49	1KV 100%		DD 101	
27					
28					
29	C33, C34, C35, C36, C37, C39, C42, C43, C44, C45, C46, C47, C48, C50, C51, C52, C53, C54, C55, C58, C59	DIODE	FAIRCHILD	1N4446	
30		SCR	SOUTHEX	SCR 1	
31		DIODE	WAVETEK	20-506	
32					
33					
34	C7	MYLAR 50 VDC 20%		639	
35	C69	MOLDED DISC 1KV 5%		470	
36			FAIRCHILD	8A190-5A	
37	C38			2N3799	
38			MOTOROLA	2N3440	
39	C70, C71, C72, C73, C74, C75, C76		FAIRCHILD	2N3646	
40				2N3638	
41			FAIRCHILD	2N3903	
42				2N3903	
43	Q37, Q38	MATCHED 2N3906	FAIRCHILD	DL 1906	
44	Q10, Q11		MOTOROLA	2N3640	
45	Q1, Q2				
46	Q39, Q40, Q41		FAIRCHILD	2N3646	
47	Q30, Q31			2N3638	
48	Q12, Q15			LO6	
49	Q13, Q16			2N2369	
50	Q20			2N2905A	
51	Q39		MOTOROLA	2N2219A	
52					
53					
54					
55					
56					

PARTS LIST

ITEM	REF DES	DESCRIPTION	VENDOR	VENDOR NO	QTY
1	IC1, IC2	LINEAR IC (-13)	NATIONAL	LM1709C	2
2					
3	Q36	DUAL TRANS	ANALOG		
4		LINEAR			
5	Q7, Q17		NATIONAL	LM394C	2
6	Q28			9014	
7					
8					
9	R58, R59	POWER HOUSING (20)		34-621-820	2
10	R120, R121			2501	
11	R110, R113			500Ω	
12					
13					
14	R60, R61, R62			2.5K	
15	C60			1K	
16					
17	R63, R64, R65			100K	
18	C80			1K	
19	R110				
20					
21	R162, R163	CARBON, 5% 0.2W		RCR-2701-5R5J	2
22	R164	CARBON, 10% 0.2W		CC0204 RB7	
23	R98, R99			47Ω	
24	R94, R95			4.7Ω	
25	R96, R97			10Ω	
26	R100, R87			100Ω	
27	R88, R89			470Ω	
28	R90, R91			1K	
29	R92, R93			4.7K	
30	R94, R95			10K	
31	R96, R97			47K	
32	R98, R99			100K	
33	R100, R101			470K	
34	R102, R103			1M	
35	R104, R105			4.7M	
36	R106, R107			10M	
37	R108, R109				
38	R110, R111			1.5K	
39	R112, R113			2.2K	
40	R114, R115			3.3K	
41	R116, R117			4.7K	
42	R118, R119			6.8K	
43	R120, R121			10K	
44	R122, R123			15K	
45	R124, R125			22K	
46	R126, R127			33K	
47	R128, R129			47K	
48	R130, R131			68K	
49	R132, R133			100K	
50	R134, R135			150K	
51	R136, R137			220K	
52	R138, R139			330K	
53	R140, R141			470K	
54	R142, R143			680K	
55	R144, R145			1M	
56	R146, R147			1.5M	
57	R148, R149			2.2M	
58	R150, R151			3.3M	
59	R152, R153			4.7M	
60	R154, R155			6.8M	
61	R156, R157			10M	
62	R158, R159				
63	R160, R161				
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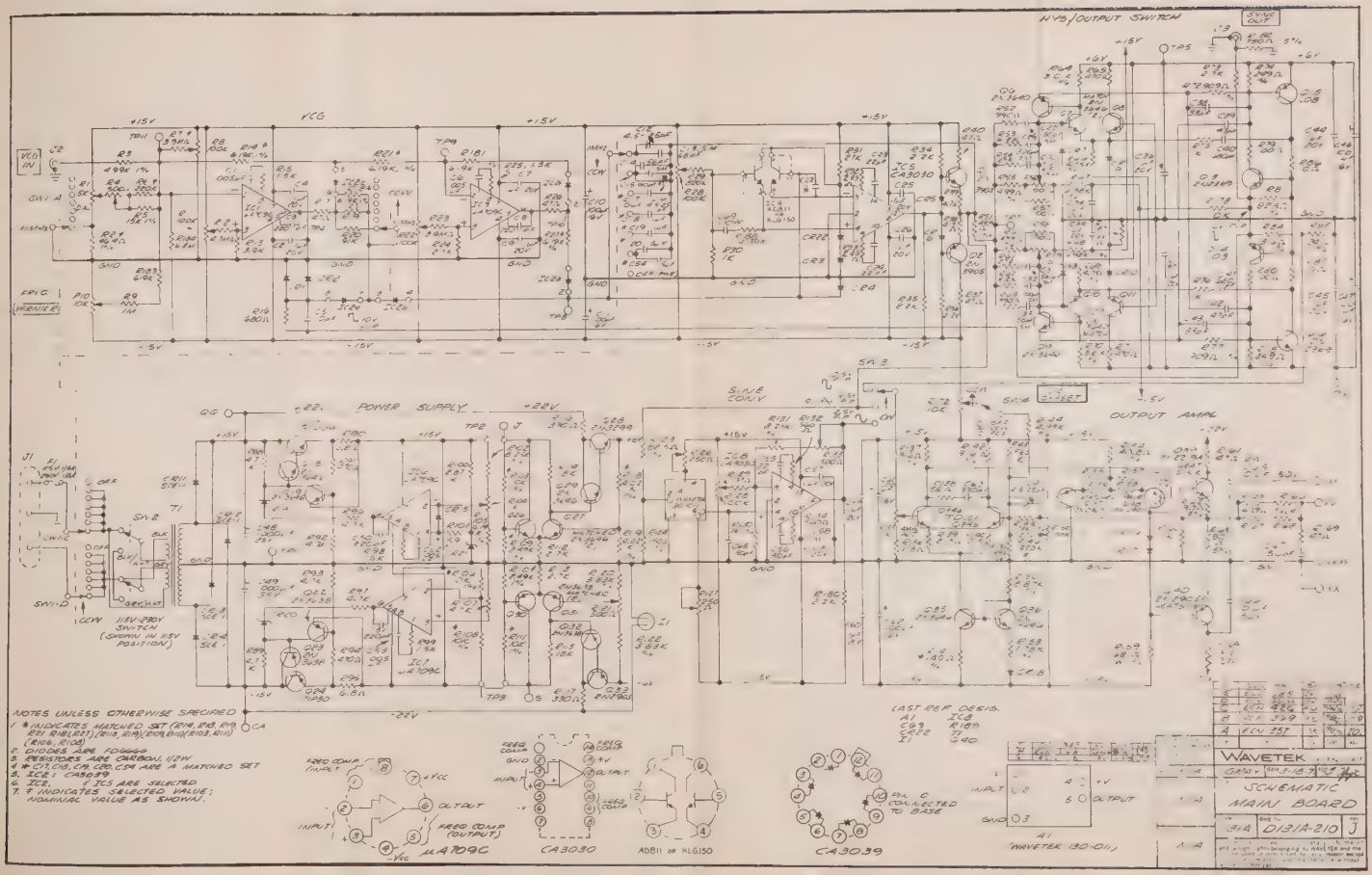
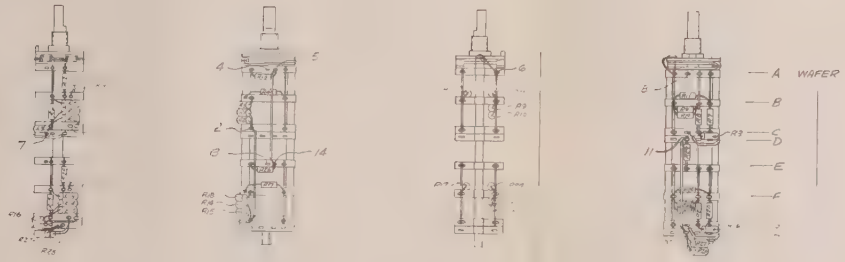
PARTS LIST

ITEM	REF DES	DESCRIPTION	VENDOR	VENDOR NO	QTY
1	R55-R150	METAL FILM, 1/4W, 1%	Dale/MG	EM600	
2		51.5Ω			
3		464Ω			
4		499Ω			
5		1.07K			
6		1.65K			
7		2.87K			
8		5.11K			
9		7.87K			
10		9.31K			
11	R54, R137	11.8K			
12		13.7K			
13	R53, R60	15.8K			
14		20.5K			
15		23.7K			
16		27.4K			
17		31.6K			
18		36.5K			
19		42.2K			
20		48.7K			
21		56.2K			
22		64.9K			
23		75K			
24		86.6K			
25		100K			
26	SW. 2	WAVER	ERS	22-SW-2	
27	SW. A			T106	
28	SW.	DETENT	WAVETEK	30-SW1	
29	SW. 1B	MOUNTED		193-SW1-1	
30	SW.2	SWITCH		130-420	
31					
32		FRONT PANEL MARKED	WAVETEK	08-267	
33		FRONT PANEL	WAVETEK	130-334	
34				130-335	
35		LEVELS			
36		LAND	WAVETEK	08-268	
37					
38		SIDE MODULE BRACKET ASSY	WAVETEK	8.90-077	
39				8130-001	
40		CIRCUIT BOARD		76-15	
41		SUPPORT BLOCK		8190-328	
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					


HYS/OUTPUT SWITCH
SYNC OUT
+15V
VCO
VCO IN
SW1.A
SW1.B
SYM
FREQ
AMPLITUDE
POWER SUPPLY
+22V
-22V
SINE CONV
SW1.3
SW1.4
OUTPUT AMPL
SW1.2
115V-230V SWITCH (SHOWN IN 115V POSITION)
NOTES UNLESS OTHERWISE SPECIFIED
1. * INDICATES MATCHED SET (R14, R18, R19, R21, R18(R22), (R110, R119), (R101, R102, R103, R111), (R106, R108)
2. DIODES ARE FOX-LG
3. RESISTORS ARE CARBON, 1/2W
4. ** C17, C18, C19, C20, C24 ARE A MATCHED SET
5. IC1: CA3039
6. IC2, IC3 ICS ARE SELECTED
7. † INDICATES SELECTED VALUE; NOMINAL VALUE AS SHOWN.
LAST REF DESIG.
A1
IC8
C69
R139
C122
Z1
D40
A1 (WAVETEK 130-011)
WAVETEK
SCHEMATIC
MAIN BOARD
D131A-210
J
LM709C
CA3030
ADB11 or HLG150
CA3039



PARTS LIST						
ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
1	R3 R16	RES METAL FILM 1/8W 1% 274Ω	CORNING	RN60D	2
2	R29	499Ω			1
3	R4 R17	54.9Ω			2
4	R5 R13 R18, R26	59Ω			4
5	C 1-24	6.9Ω			4
6	R8 R21	71.5Ω			2
7	R27, R28	100Ω			2
8	R1 R2 R9 R10 R14 R15 R22 R23	196Ω			8
9	R7 R20	249Ω			2
10	R6 R12 R19 R25	825Ω			4
11					
12					
13					
14					
15		DETENT AND WAFER ASSY	WAVETEK	131A-SW1	1
16					
17					
18					
19					
20					

NOTES UNLESS OTHERWISE SPECIFIED

1 NUMBERS INDICATE WIRE TERMINATION POINTS SEE D131A-200

tolerance unless otherwise specified XXX ± .010 XX ± .030	rev	ecn	by	date
scale FULL	WAVETEK			
material N/A	by BOUCHARD	date 2 5 71	app	
finish N/A	title ASSY- ATTENUATOR SW			
	model no 131A	dwg no D131A-00.		rev

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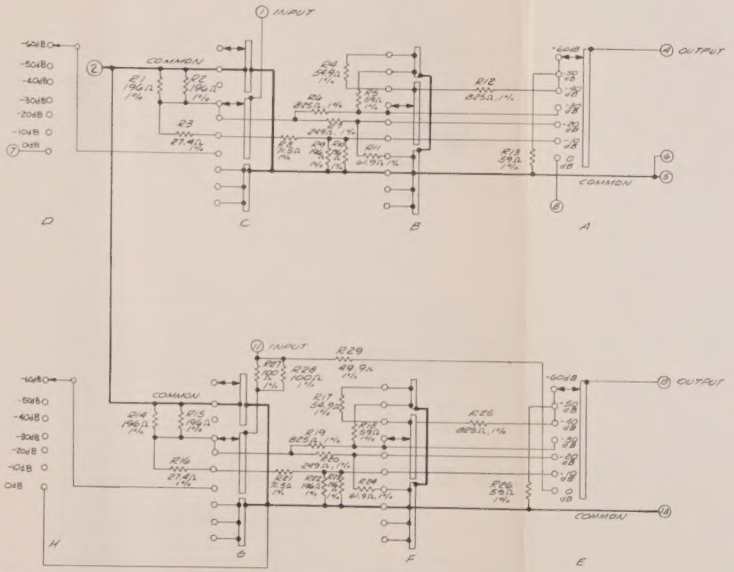

NOTES: UNLESS OTHERWISE SPECIFIED

1. CIRCLED NUMBERS, I.E. ① ETC, INDICATE WIRING INTERCONNECTIONS
2. SEE SCHEMATIC 131A-200

tolerance unless otherwise specified: XXX ± .010, XX ± .020	rev.	ecn	by	date	app
scale N/A	WAVETEK san diego, calif				
material N/A	by Gaw	date 7-17-73	title SCHEMATIC ATTENUATOR		
finish N/A	model no. 131A	dwg no. D131A-201	rev		

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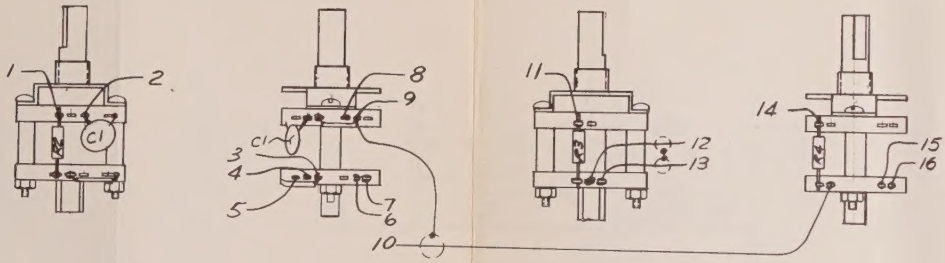

PARTS LIST					
ITEM	REF DES	DESCRIPTION	MFGR	MFGR NO	QTY
1	R2	RES METALFILM 1/4W, 1% 49.9Ω	CORNING	RN60D	1
2	R3, R4	249Ω			2
3					
4					
5	C1	CAPACITOR, DISC 1000V, .0022uf	CRL	DD-222	1
6					
7		DETENT	WAVETEK	134-304-7	1
8		WAFER	CTS	T109	2
9		STANDOFF (1/2" SPACER)	CTS		2

NOTES:

1 FOR SCHEMATIC SEE D131A-200

TOLERANCE UNLESS OTHERWISE SPEC: XXX .010, XX .030, ANGLES 0 30	REV	ECN	BY	DATE
SCALE FULL	WAVETEK SAN DIEGO CALIF			
MATERIAL N/A	BY BOEHME DATE 2-16-71			
FINISH N/A	TITLE ASS'Y OUTPUT SWITCH			
	MODEL NO 131A	DWG NO D131A-002	REV	

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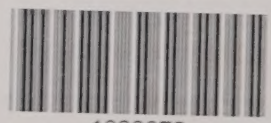

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